CONCEPT CHECKS ANSWER KEY!!!

1.1 GEOLOGY: THE SCIENCE OF EARTH

1. The two subdivisions of geology are *Physical Geology* and *Historical Geology*. Physical geology focuses on the materials that Earth is made of and the processes that operate on the surface and inside Earth. Historical geology focuses on the origin of Earth and how Earth and life on it have changed through time.

2. Several geologic hazards would include volcanic activity, floods, and earthquakes.

3. Aside from geologic hazards, describe another important connection between people and geology. An important connection between geology and people includes the resources from Earth that we exploit and depend upon. These resources include groundwater, hydrocarbons for energy, and various base and precious metals as well as industrial and agricultural mineral resources.

1.2 THE DEVELOPMENT OF GEOLOGY

1. Because of Aristotle's influential reputation as an authority on many subjects, his nonscientific and arbitrary descriptions about the natural world remained accepted which inhibited other investigations into questions about Earth until after the Renaissance.

2. Catastrophism holds that Earth's features were formed by sudden and unrelated catastrophes. Uniformitarianism holds that Earth's geologic processes operate based on a *uniform* set of physical laws that operate today and throughout Earth's history. Catastrophists view the age of Earth as very young and align with biblical doctrine established by Bishop Usher. Uniformitarianists recognize that the processes shaping Earth operate slowly and so must operate over long periods of time to achieve the geologic change that we observe.

3. The current estimate for the age of Earth is 4.6 billion years old.

4. a. Eon: Phanerozoic
b. Era: Cenozoic
c. Period: Quaternary
d. Epoch: Holocene

5. An understating of the vastness of geologic time is important because the processes shaping the earth operate so slowly that long periods of time are needed to achieve the changes we observe.

1.3 THE NATURE OF SCIENTIFIC INQUIRY

1. A scientific hypothesis is simply an untested explanation for a set of observations. Once a hypothetical explanation is subjected to many tests and scrutiny and is not eliminated as a viable explanation, it can be considered a theory.

2. A scientific investigation starts by asking a question and collecting data related to the

question. From the data collected, one or more hypotheses are formulated to explain the data, and then experiments are conducted to test the hypotheses. The tests serve to accept, modify, or reject a hypothesis. Finally, the data and results with the surviving hypotheses undergo peer examination in the scientific community.

3. Continental drift existed as a hypothesis for over 50 years while observations and data were gathered that eventually led to the development of a sound theory that included many topics other than "continental drift."

1.4 EARTH'S SPHERES

1. a. Hydrosphere: The hydrosphere encompasses all of Earth's water. This includes water vapor in the atmosphere, all the liquid water of the oceans, the fresh water underneath the ground and in the lakes and streams as well as the solid water in the form of ice in glaciers.
b. Atmosphere: The atmosphere is the gaseous envelope that surrounds Earth and provides the elements we call *weather* and *climate.*
c. Biosphere: The biosphere encompasses all the life on Earth and, in a broad sense, all of the places on Earth where life can exist.
d. Geosphere: The geosphere encompasses the entire solid, inorganic portion of Earth.

2. Compared to the thickness of the solid Earth, which is about 6400 kilometers (4000 miles), the atmosphere is very shallow with 90 percent of its mass within 16 kilometers (10 miles) of the surface.

3. Oceans cover 71 percent of Earth's surface and account for almost 97 percent of all of Earth's water.

4. Soil can be thought of as a part of Earth where all four spheres overlap and are represented.

1.5 EARTH AS A SYSTEM

1. A system is a collection of simpler parts that operate as a more complex whole. Three examples include: *financial (or banking) systems*, *weather systems*, and *transportation systems.*

2. The Sun provides energy to the exterior of Earth. The second energy source is the interior heat of Earth left over from planet formation and generated by radioactive decay.

3. Changes in the hydrologic cycle subsystem would cause some plants to thrive better and some to disappear, therefore affecting food sources for animals. The geosphere would change in terms of differences in soil development and rates of erosion.

1.6 EARLY EVOLUTION OF EARTH

1. The solar nebular theory holds that a cloud of gas and dust, the nebula, contracted under the force of gravity, flattening into a spinning disk. The protosun forms at the nebula's center and as gas and dust condense around the protosun, planetesimals begin to collect from the matter in the spinning disk. More and more material is swept up from the disk by the

planetesimals until the current configuration of planets is achieved.

2. a. Inner planets: Mercury, Venus, Earth, and Mars are the smaller planets of the solar system and contain mostly iron, nickel, and the rock-forming elements such as silicon, calcium, and sodium.
b. Outer planets: Jupiter, Saturn, Uranus, and Neptune are the larger planets composed mostly of extremely large amounts of ice, carbon dioxide, ammonia, and methane with minor amounts of rocky material and metals.

3. As early Earth heated and metallic elements began to melt, they sank to the center of Earth due to their density. Lighter elements formed more buoyant magmas that rose closer to the surface taking other light elements and elements that were soluble in the magma with them. This created a layered structure based mostly on density or association with magmas of specific buoyancies.

1.7 EARTH'S INTERNAL STRUCTURE

1. The three major compositional layers of Earth are the core, mantle, and crust. The core is composed mostly of an iron-nickel metal alloy and only minor amounts of lighter elements (those that readily bond with iron—oxygen, silicon, and sulfur). The mantle is composed of true *rock* containing silicate minerals that are high in iron and magnesium. The crust consists of a more varied composition than the mantle or core. That portion of the crust underneath the oceans, the *oceanic crust*, is composed of rocks containing iron- and magnesium-rich minerals, but not as much as the underlying mantle. The portion of the crust comprising the continents, the *continental crust*, has a more varied composition than ocean crust, but, in general, contains less iron- and magnesium-rich minerals giving an average density of 2.7 g/cm$_3$ while the ocean crust is denser (about 3.0 g/cm$_3$).

2. The lithosphere and asthenosphere are subdivisions of Earth's interior that are defined based on physical properties and behavior rather than chemical composition. The lithosphere consists of the entire crustal layer and the upper portion of the mantle and behaves as relatively cool, solid, rigid material. The underlying asthenosphere is hotter and behaves as a softer, weaker material than the lithosphere. Because of the property differences between the lithosphere and asthenosphere, they are able to move independently of each other.

3. The outer core is hot enough for the specific composition of iron and nickel present to melt and remain liquid at the pressures that occur there. The movement of the liquid metal alloy of the outer core is what generates Earth's magnetic field. The inner core, by contrast, is under much more pressure and, although hotter than the outer core, is not hot enough to remain molten and so is solid iron-nickel.

1.8 ROCKS AND THE ROCK CYCLE

1. A rock's mineral composition and texture reflect the geologic processes that created it.

2. Rock cycle diagram.

3. Igneous rocks and metamorphic rocks can provide the raw material for sedimentary rocks if

the rock is exposed at the surface and weathers into sediment. The igneous rocks can be the raw material for metamorphic rocks if the igneous rocks remain buried and are subjected to compressional forces and high temperatures. Sedimentary rocks are the raw material for metamorphic rocks when the sedimentary rocks are buried deeply and are subjected to the compressional forces and temperatures associated with mountain building. Any of the three rock types can be the raw material for igneous rock if they are subjected to geologic settings that provide enough heat to melt the preexisting rock.

1.9 THE FACE OF EARTH

1. The continents are composed mostly of granitic rocks with an average density of 2.7 g/cm$_3$ while the ocean basins are composed of basaltic rocks with an average density of 3.0 g/cm$_3$. This difference in density allows the continents to float higher on the underlying mantle than the ocean crust. In addition, except for a limited area of mountainous relief, the continents are rather flat features with an average elevation of 0.8 kilometers (0.5 mile) above sea level. In contrast, the ocean basins have an average depth of 3.8 kilometers (2.4 miles) below sea level.

2. The youngest mountains of Earth are in two major belts. One, the circum-Pacific Belt, lies on the edges of the continents that enclose the Pacific Ocean. The other extends from the Alps in Europe through Iran, into the Himalayas and then southward into Indonesia where it connects with the circum-Pacific belt.

3. Cratons are the older, relatively stable interiors of continents and the shields are the exposed areas of the craton. The stable platforms are those parts of the craton that have been covered by relatively thin deposits of younger sedimentary rocks.

4. The three major regions of the ocean floor are: the continental margin, the deep-ocean basin, and the oceanic ridges. The continental margin consists of the continental shelf, which is the flooded edge of the continent, and the continental slope and rise, which are the boundaries between the continents and the ocean basin. The deep-ocean basin consists of the abyssal plains, which are incredibly flat areas and extremely deep areas called the deepocean trenches. Other features present on the ocean basins are chains of submerged volcanic remnants called seamounts. Finally, the ocean ridges consist of layers